STAR 200 LOW PRESSURE AIR COMPRESSOR PURCHASE SPECIFICATION

1.0 SCOPE

This specification contains requirements for a Single screw Technology Air Rotary (STAR) 200 Low Pressure Air Compressor (LPAC) equipped with a Programmable Logic Controller (PLC) to replace the existing LPACs currently being used on the USS MOUNT WHITNEY (LCC-20).

2.0 APPLICABLE DOCUMENTS

2.1 General. The STAR 200 LPAC shall be built to NAVSEA Drawing 803-6915565, Revision B, dated 20 Oct 2000, with the following exceptions/substitutions:

2.1.1 The Standard Electronic Module (SEMs) based microprocessor controller that is shown on the drawing will be replaced with a Programmable Logic Controller (PLC) built in accordance with the enclosed specification.

2.1.2 The existing transducers (MFR. P/N 1PT-67-812-150A and drawing P/N 6915567-6.2) used for Discharge Air Pressure, Ship Air Pressure and Injection Water pressure will be replaced with either of the following options:

2.1.3 P/N 33 - Transducer by CAGE 28953 with associated software

2.1.4 Model 89 QPL manufactured by Ametek

2.1.5 The existing air end cover casting (P/N 6915566-23C) will be replaced by Plexiglas covers.

2.1.6 The existing air end/motor coupling (P/N 6915568-2.7) may be replaced by appropriate coupling manufactured by Lovejoy, Inc.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation.

SPECIFICATIONS

MILITARY

MIL-S-901D	17 March 1989	Shock Tests, High Impact, Shipboard Machinery, Equipment and Systems, Requirements for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	1 May 1974	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental)

MIL-STD-461E	20 Aug 1999	Requirements for the Control of Electromagnetic Interference – Characteristics of Subsystems and Equipment
MIL-STD-777E	1 Jun 1995	Schedule of Piping, Valves, Fittings and Associated Piping Components for Naval Surface Ships

2.2.2 Other Government Documents

NAVSEA Technical Publication S9074-AR-GIB-010/278, dated 1 Aug 95. Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, piping and Pressure Vessels.

2.2.3 Non-Government Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposals shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D3951	10 Aug 2003	Standard Practice for Commercial Packaging

3.0 TESTING All testing listed on Drawing 803-6915565, Rev B. will be performed. In addition, the following tests must also be performed:

3.1 First Article Testing

3.1.1 Shock: The compressor shall withstand the shock conditions specified for Grade A, Class II equipment of MIL-S-901D, dated 17 March 1989.

3.1.2 Vibration: The compressor shall be resistant to vibration conditions specified for Type 1 equipment in MIL-STD-167-1, dated 1 May 1974.

3.1.3 Electromagnetic Interference (EMI): The compressor shall meet and demonstrate compliance with the requirements of MIL-STD-461, Rev E (dated 20 August 1999) for Surface Ship, Below Deck, Metallic Hull installations.

4.0 DOCUMENTATION

4.1 The contractor shall provide First Article Test Plans for Shock, Vibration and EMI tests.

4.2 The contractor shall provide First Article Test Reports for Shock, Vibration and EMI test results.

4.3 The contractor shall provide Engineering Data For Provisioning for parts and assemblies to the detail of Level 2 Drawings.

4.4 The contractor shall provide a Test Plan for a Quality Conformance Production Test.

4.5 The contractor shall provide a Test Report for the Quality Conformance Production Test on each manufactured unit.

4.6 The contractor shall provide electronic copies required change pages to Navy Technical Manual S6220-EE-MMA-010, showing all configuration, operation, maintenance, and parts breakdown differences between the unit supplied under this contract and those currently in the Fleet, covered by Technical Manual S6220-EE-MMA-010.

5.0 PACKAGING Packaging shall be in accordance with ASTM 3951.

6.0 ENCLOSURE (1)

STAR-200 PROGRAMMABLE LOGIC CONTROLLER (PLC) PURCHASE SPECIFICATION is provided as an enclosure to this specification.

ENCLOSURE (1)

STAR 200 PROGRAMMABLE LOGIC CONTROLLER (PLC) PURCHASE SPECIFICATION

1.0 SCOPE

This specification contains requirements for a Programmable Logic Controller (PLC) for use on STAR 200 Low Pressure Air Compressors (LPAC). The PLC shall be a replacement for the existing SEMs based microprocessor controller currently being used on the STAR 200. This PLC shall be a form, fit, and functional replacement. The PLC shall perform, at a minimum, the same functions as the existing SEMs controller.

2.0 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in section 3.3, 3.4 or 3.5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in section 3, 4 or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation.

SPECIFICATIONS

MILITARY

MIL-DTL-2212H	10 February 1997	Contactors and Controllers, Electric Motor AC or DC, and associated switching devices
MIL-E-2036D	10 March 1988	Enclosure for Electrical and Electronic Equipment, Naval Shipboard

FEDERAL

FED-STD-595B/26037	11 January 1997	Gray, Semigloss

DEPARTMENT OF DEFENSE STANDARDS

DOD-STD-1399	1 Aug 1978	Section 300: Interface Standard for Shipping Systems Electric Power, Alternating Current. (metric)

TECHNICAL MANUALS

NAVSEA S6220-EE-MMA-010	1 Jun 2002	Compressor, Air, Low Pressure, Oil Free Model STAR 200

DRAWINGS

NAVSEA 803-6915567, Rev A	27 Dec 1996	L.P. STAR COMPRESSOR ELECTRICAL SYSTEM

2.2 Non-Government Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposals shall apply.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

IEEE 802.3	13 Jun 2002	Information Technology – Telecommunications and Information Exchange between systems – LAN/MAN Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
IEEE C95.1	1 Jan 1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency and Electromagnetic Fields, 3 kHz to 300 GHz

(Applications for copies are available from IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08855-1331 or www.ieee.org.)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 61131-2	1 Feb 2003	Programmable Controllers – Part 2: Equipment Requirements and Tests

IEC 61131-3	1 Jan 2003	Programmable Controllers – Part 3: Programmable Languages

(Applications for copies are available from the IEC, UBS SA, 1201 Geneva, Switzerland or www.iec.ch)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

ICS 2	1 Jan 2000	Industrial Control and Systems: Controllers, Contactors and Overload Relay, Rated no more than 2000 Volts AC or 750 Volts DC
250	1 Jan 2003	Enclosures for Electrical Equipment (1000 Volts Maximum)

(Applications for copies should be addressed to the National Electrical Manufacturing Association, 2101 L Street, NW Suite 300, Washington, D.C. 20037 or www.nema.org.)

U.S. Product Data Association (US PRO)

ANS US PRO/IPO 100 IGES 1996 Graphical Format, Requirements for

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Y14.100	1 Jan 2000	Engineering Drawing Practices (1/1/2000)

2.3 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulation unless a specific exemption has been obtained.

3.0 TECHNICAL SPECIFICATION

3.1 First Article. When specified, samples shall be subjected to first article inspection in accordance with 3.5. The first article shall consist of two units.

3.2 Maintainability. The PLC shall be such that all maintenance, both corrective and preventive, can be accomplished at the organizational level with no outside assistance. Personnel with no formal equipment training shall be able to accomplish preventative and corrective maintenance.

3.3 General Description. The current Navy STAR 200 Low Pressure Air Compressor is controlled by a LaBarge, Incorporated Compressor Management System (CMS), part number 66612188. This is a SEMs based microprocessor controller described in Navy Technical

Manual S6220-EE-MMA-010. The PLC shall replace existing SEMs controller while performing the same functions, at a minimum.

3.3.1 Physical Parameters. The PLC shall not cause the Low Pressure Air Compressor package to exceed the dimensions, maintenance clearances or weight of the present configuration. The PLC shall mount to the existing bolt pattern for the CMS without interfering with other existing components. The top of the PLC shall be no higher than 44 inches from the base plate. The PLC shall be no wider than 21 inches and no deeper than 9 inches.

3.3.2 Materials. Materials of construction shall be corrosion resistant in a marine environment. Critical parts shall be made of corrosion-resistant materials such as corrosion-resistance steel, corrosion-resistant nickel-copper aluminum alloy, nickel-copper alloy, bronze or equivalent alloys. Cast iron shall not be used for any components.

3.3.3 Included Parts. The controller shall be supplied with a Central Processing Unit (CPU), inputs, outputs, network interface(s), memory, power supply, power and interface cables, and software necessary to function with existing STAR 200 LPAC.

3.3.4 Design. The PLC shall be designed to allow an easy interface to existing systems. The PLC design shall allow for expansion of the system by the addition of hardware and/or user software.

3.4 Program Requirements. The PLC shall be programmed to include functionality for controlling, alarming, data storage (alarms and data). Data values shall be scaled in standard U.S. engineering units (PSI, Deg F, Gallons, Pounds, Feet/Inches, etc.) in the PLC throughout the program, and made available to the operator interface and network as such. The PLC shall detect and record alarm conditions and shutdown data (i.e. overpressure conditions, controller memory faults, controller execution faults, high temperature and high pressure) in the central processing unit for failure analysis. The failure data (time and date of system failure/shutdown as well as vital information on temperature, pressure and tank levels) shall be available for downloading.

3.4.1 Inputs/Outputs (I/O). The controller shall have sufficient I/O capability to input all process variables required for safe operation and output all manipulated variables required to completely and safely control the STAR 200 LPAC. The PLC and its enclosure shall be designed with future expansion capability (and space) for at least two additional I/O modules of the same design as the base PLC without requiring modification to original enclosure of PLC rack.

3.4.2 Network. The PLC shall be provided with network interfaces for both Ethernet and Serial Interfaces. The Ethernet interface must support TCP/IP and UDP/IP protocols. The serial interface must support IEEE 1174 standard which adds interface functionality to serial communication links. This communication port shall allow temporary installation of a portable laptop to enable displaying information in the event of display failures.

3.4.3 Memory. The PLC shall be equipped with sufficient memory to perform all of the above functions and have at least 50% excess capacity. The PLC's microprocessor shall operate the LPAC, store pertinent data and transmit data to a graphical display via the computer.

3.4.4 Programming Interface. The PLC shall be equipped with a local programming interface for a standard laptop computer using programming software. Software shall conform to requirements detailed in paragraph 3.4.7. Controller software shall not be used as a final safety check for high temperature and high pressure fault detection. The controller shall be programmed for data acquisition from pressure and temperature transducers and switches, differential pressure transducers, analog inputs and outputs and any other pertinent data points. The PLC shall input system parameters and shall use this data to provide operator prompting for system start up, operation and shutdown via a PC computer interface.

3.4.5 Power Supply. The power to the controller, computer and graphics display shall be obtained from the LPAC's High Voltage Enclosure. As the existing High Voltage Enclosure will not be readily compatible with a PLC, the vendor has the option of supplying a new HVE, or altering the existing HVE to accommodate the new PLC. The existing electrical configuration can be found in NAVSEA Tech Manual S6220-EE-MMA-010 and NAVSEA Drawing 803-6915567.

3.4.6 Operator Interface (OI). The PLC shall be equipped with a direct interface to a programmable OI display. The OI shall be a flat panel color touch screen display with programmable screen views. The OI shall contain graphical (programmable) pushbuttons and data displays as required for an operator to start, stop, manually control and view all processes required for safe STAR LPAC operation. The OI shall have separate screen views for alarming, and trending, operator control, and process monitoring of the LPAC. The following OI are required: Power ON/OFF, Auto/Manual, Start, Stop, and as a minimum for lights to indicate Power ON, Running, etc. The PLC shall be capable of accepting input from the operator to allow for emergency operation. The operator shall be able to monitor and modify maintenance requirement messages, access troubleshooting test functions, and monitor alarm set points and incident histories. The controller shall also be capable of interfacing with a computer and a touch screen display to enable transmission of real time data when prompted. The data recorder shall be able to download and record information from the controller processor via a suitable and portable communication interface (i.e. an RS-232 port).

3.4.6.1 Integrated Condition Assessment System (ICAS). The PLC shall be capable of interfacing with the Navy's Integrated Condition Assessment System (ICAS) and must have the proper port configuration in order to be compatible with ICAS. Existing port configuration can be found in NAVSEA Tech Manual S6220-EE-MMA-010 and NAVSEA Drawing 803-6915567.

3.4.6.2 Operator Screen View. The operator screen view shall provide a means for the operator to control the LPAC. It shall have the ability to start and stop the LPAC via soft pushbuttons, and to manually take control of the following processes at a minimum: ON, OFF, START UP, SHUT DOWN, MANUAL operation and AUTOMATIC operation.

3.4.6.3 Alarm Screen View. The alarm screen view shall provide a display of all relevant alarm conditions associated with the LPAC. The alarm screen shall provide a means for the operator to acknowledge and clear alarm conditions as appropriate.

3.4.6.4 Trend Screen View. The Trend Screen View shall provide a means to graphically view several processes in real-time.

3.4.6.5 Process Monitoring Screen View. The Process Monitoring Screen View shall provide a graphical view of the most relevant process variable to provide the operator a quick view of the LPAC operation. It shall contain only the most relevant parameters (levels, pressures, temperatures) needed to assess operation. Secondary level graphical views may be provided for display of additional detailed data parameters.

3.4.7 PLC/PC Software Development and Documentation. All software (PLC and PC) shall be developed in compliance with IEE/EIS 12207. If commercially available software meets all requirements specified herein, compliance to IEEE/EIS 12207 is not required. This would only be allowed if the commercially available software is utilized "as is" and NO software changes are required. Compliance to IEEE 12207 requires that all software development shall be planned, managed and documented appropriately throughout the software development lifecycle. Those requirements of IEEE/EIS 12207 that are to be adhered to during the software development lifecycle shall be identified in the Statement Of Work (SOW) Contract Deliverable Requirements Lists (CDRLs) and the associated Data Information Descriptions (DIDs). All developed software must have defined software requirements that are traceable from design to code and test. All software requirements must be consistent, feasible and verifiable. All developed software executable, source code, and documentation shall be the property of the US Navy. The software shall NOT be considered proprietary. If passwords or other security measures are employed, those passwords, security measures and codes shall be delivered with the producer. Commercially available software for PC and PLC communication can be used to enable the prompts/interactions stated herein. If this option is pursued, the government shall be supplied with all rights and licensing agreements for use said software. All embedded software shall not be susceptible to potential viruses when using communication ports specified herein.

3.4.8 Hardware Supportability. The control system hardware shall be original equipment manufacturer (OEM) supportable for a minimum of 15 years. The OEM shall provide guaranteed replacement parts support within a maximum of 48 hours from time of order for all control system components.

3.4.9 Logic Function. The internal wiring of the controller shall be fixed, and all logic functions that shall be performed in a given application shall be programmed into its memory.

3.4.10 Duty. The PLC shall operate for a continuous duty.

3.4.11 Cooling. All system modules shall provide free airflow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.

3.5 Performance Requirements

3.5.1 Operating Temperature. The PLC shall operate at an ambient temperature of 0 to 60 degrees Celsius and a storage ambient temperature of –40 to 85 degrees Celsius.

3.6 Workmanship. PLC units shall be constructed, assembled, and finished to assure quality equipment and neat appearance that is free from imperfections that will affect durability, operability, and serviceability, and safety. The metal edges of the units shall be free from fins, burrs, and sharp and rough edges.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General inspection requirements.

4.1.1 General provisions for inspection. Inspection as used herein shall be understood to mean the examination and testing, as applicable, of materials, fabricated components, the manufacturing processes, the completed PLCs thereof, to determine and ensure conformance to the specifications set forth in the contract or purchase order.

4.1.1.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor shall be responsible for the performance of all inspection requirements (examinations and tests) specified herein. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to the prescribed requirements.

4.1.1.2 Responsibility for compliance. All items shall meet all requirements of section 3. The absence of any inspection requirements in this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract.

4.1.1.3 Government participation. The contractor shall notify the procuring activity at least ten working days prior to commencement of first article tests. The Government reserves the right to witness the First Article tests to be performed by the contractor.

4.1.2 Inspection system. The contractor must possess a quality or inspection system that conforms to the requirements of a higher-level quality or inspection program, such as ANSI/ISO/ASQC Q9001 or Q9002.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4)

4.3 First Article Inspection

4.3.1 General

4.3.1.1 First Article testing is accomplished to ensure the PLC complies with the requirements of the specification.

4.3.1.2 Units submitted for First Article testing shall be standard production models.

4.3.2.1 First Article Tests First Article Inspection shall consist of the examination and tests specified herein and shall be conducted in the following order:
(a) Visual and dimensional examination
(b) Performance test
(c) Shock test
(d) Vibration test
(e) EMI test

4.3.2.1.1 Visual and Dimensional Examination Each PLC shall be examined to determine conformance to this specification. Equipment shall be surface examined including visual examination for defects, workmanship, dimensions and any other requirements not involving tests.

4.3.2.1.2 Performance Test The performance test will be accomplished by the contractor as follows:

4.3.2.1.2.1 Test Conditions The first article unit shall be tested attached to a STAR 200 LPAC. The air compressor will be run in the following configurations:

(a) Unloaded for one hour
(b) Loaded for three hours:
    a. One hour in Lead
    b. One hour in Lag
    c. One hour in Standby
(c) Battle Override for one-half hour

During these tests, the following parameters will be measure every 15 minutes:

(a) Injection Water Pressure
(b) Discharge Air Pressure
(c) Shipboard Air Pressure
(d) Sea Water Inlet Pressure
(e) Sea Water Outlet Pressure
(f) Injection Water Temperature
(g) Discharge Air Temperature
(h) Sea Water Inlet Temperature
(i) Sea Water Outlet Temperature
(j) Tank Level

Upon completion of above tests, the following tests will be completed with compressor in Lead Mode:

(a) Injection Water Solenoid Valve – Tank will be drained via the PLC until the compressor Injection Water Solenoid Valve is opened.
(b) Separator Drain Valve – Tank will be filled via the PLC until the compressor Drain Solenoid Valve is opened.

4.3.2.1.2.2 Acceptance criteria. The first article unit shall be considered to have passed the performance test if the following criteria are met at all times during the test:

(a) The compressor stays on line or trips off line for reasons other than the PLC
(b) The tests can all be accomplished using the PLC only.
(c) There are no relevant failures (see 4.3.2.2.1.4.1)

4.3.2.1.2.3 Inclined Operation The first article test unit shall be tested for compliance with required inclined operation. The compressor shall be operated at rated load for not less than 30 minutes with the base tilted 15 degrees in each of the four cardinal positions; right, left, front; rear. During the progress of these tests, there shall be no excessive heating of any parts.

4.3.2.1.3 Shock Test The first article unit shall be subjected to the type A, high-impact shock tests specified for Grade A, Class II equipment in accordance with MIL-S-901D.

4.3.2.1.4 Vibration Test The first article unit shall be subjected to test resistance to vibration in accordance with type I of MIL-STD-167-1. Vibration test procedures and testing report shall be prepared.

4.3.2.2.2 Evaluation of Failures A failure shall be defined as any hardware malfunction, which precipitates automatic or manual shutdown of the compressor or the PLC itself. Failures will be classified as either "relevant" or "non-relevant".

4.3.2.2.2.1 Relevant Failures Relevant failures are caused by:
(a) Equipment design defects
(b) Equipment manufacturing defects
(c) Parts defects
(d) Unknowns
(e) All other causes not specifically listed as non-relevant

4.3.2.2.2.2 Non-relevant Failures Non-Relevant Failures are caused by:

(a) Mishandling or improper storage or installation
(b) Operator or procedural error
(c) External test equipment or facility failure
(d) Drawing, technical manual or other documentation errors,

providing the correction is shown to eliminate future similar failures (This not be construed to include design errors.)

(e) Failures of a multiple, simultaneous or immediately sequential nature (Only the initial failure shall be counted in such cases.)

(f) Direct result of relevant or non-relevant failure of another item of equipment

(g) Improper maintenance

(h) Foreign object damage

4.3.2.2.3 Allowable Correction Action

4.3.2.2.3.1 Relevant Failure - Failures shall be identified and fully documented as to part affected, mode of failure, cause of failure, and result of failure. Upon identification of a relevant failure, the Government shall take one of the three following corrective actions:

(1) Replace the failed component(s) and continue the test at the point it was prematurely terminated.

(2) Replace the failed component(s) and restart the test from the beginning.

(3) Postpone the continuation of the test pending correction of the identified defect.

4.3.2.2.3.1 Non-relevant Failures Damaged components resulting from non-relevant failures shall be identified and replaced. The test shall be continued from the point of termination provided continuation poses no safety hazards. The failure and all corrective actions shall be fully documented.

4.4 Quality Conformance Inspection The quality conformance inspection shall be conducted as follows and shall be performed by the contractor on each production unit Condenser-Filter. The contractor may designate order of tests.

(a) Visual and dimensional examination (see 4.3.2.1.1)

5.0 PACKAGING Packaging shall be in accordance with ASTM 3951.

6.0 NOTES.

6.1 Intended use. PLCs covered by this specification are intended for general shipboard use on STAR 200 Low Pressure Air Compressors aboard US Navy ships.